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TABLE OF CONTENTS

Studies on the Distribution of the Genus *Novomessor* (Hymenoptera: Formicidae). *W. S. Creighton* 89

Obituary Notice — Professor Charles T. Brues 97

The Identity of *Macrocephalus bidens* Olivier, 1795, with a Review of the Genus *Toxonotus* Lacordaire (Coleoptera: Anthribidae). *B. D. Valentine* 98

The Ant *Centromyrmex donisthorpei* Menozzi, a Synonym. *W. L. Brown, Jr.* 103

A Gynandromorph of *Melanoplus mexicanus mexicanus* (Saussure) Extreme Migratory Phase (Orthoptera: Acrididae). *H. C. Severin* 104

Revisionary Notes on the Sanguinea and Neogagates Groups of the Ant Genus *Formica*. *E. O. Wilson* and *W. L. Brown, Jr.* . 108

Division of Labor in a Nest of the Slavemaking Ant *Formica wheeleri* Creighton. *E. O. Wilson* 130

Note on *Tarsophlebiopsis mayi* Tillyard (Odonata: Tarsophlebiidae). *F. C. Fraser* 134

Nylanderia myops (Mann), New Combination (Hymenoptera: Formicidae). *W. L. Brown, Jr.* 135

The Status of the Ant Genus *Microbolbos* Donisthorpe. *E. O. Wilson* 136

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PSYCHE

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STUDIES ON THE DISTRIBUTION OF THE GENUS NOVOMESSOR (HYMENOPTERA: FORMICIDAE)

By Wm. S. Creighton

Department of Biology, City College, New York.

During recent years the writer has taken specimens of *Novomessor albisetosus* or *N. cockerelli* at seventy-three stations[1]. As more than half of these were in northern Mexico it seems advisable to review the distribution of both species. When W. M. Wheeler and the writer monographed the genus *Novomessor* in 1934 (1) there were no Mexican records for *albisetosus* and only four for *cockerelli*. In the intervening twenty years this situation has changed scarcely at all. There are still no published records for *albisetosus* from Mexico and only one additional one for *cockerelli*. This last is, however, a most interesting record. In 1954 (2) Kannowski, in his important account of the habits of *N. manni*, noted that Cantrall has recently taken specimens of *cockerelli* at Rincon de Romos (6100′) in the state of Aguascalientes. Cantrall's record establishes the fact that the range of *cockerelli* extends into the tropics, but it should be clear that, because of the lack of published data, the distribution of *albisetosus* and *cockerelli* in northern Mexico has remained largely conjectural.

On the following pages I have presented not only records from Mexico but also a number from the United States. This is necessary to demonstrate the significant difference in the response of the two species to elevation. Dr. Wheeler and the writer failed to appreciate this difference in 1934 and, in consequence, gave a very unsatisfactory account of the vertical range of the two species. It now appears that response to elevation is what mainly determines the range of each species. The figures for elevation which follow were secured from altimeter readings made at the station and checked then or later against topographic sheets.

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[1] Field work done on a Guggenheim Fellowship.

Novomessor albisetosus:

TEXAS: Davis Mountains, Limpia Canyon (4800′), 2 miles south of Indian Hill (5300′); Chinati Mountains, Arsarca Canyon (4800′).

ARIZONA: Huachuca Mountains, Garden Canyon (5800′) Carr Canyon (5000′), Ft. Huachuca (5100′); Dragoon Mountains, Cochise Stronghold (5200′); Peloncillo Mountains, Cottonwood Canyon (4800′); Baboquivari Mountains, Forestry Cabin (3500′), Brown Canyon (3900′); Chiricahua Mountains, Nat. Mon. Camp Ground (5200′); Pima County, Total Wreck Mine (4400′), 30 miles east of Sells (2800′); Santa Cruz County, 5 miles north of Nogales, (3900′), Pena Blaca Springs (3700′), Ruby (4600′); Hasayampa River, 5 miles south of Wickenberg (1800′); 5 miles south of Clifton (3200′).

SONORA: Cerro San Jose, 10 miles southwest of Naco (5100′); 5 miles north of Santa Cruz (4700′); Cibula (3600′); La Casita (3400′); 5 miles north of Imuris (3100′).

CHIHUAHUA: Sierra de en Medio, Nogales Ranch (5000′); 9 miles north of El Sauz (4900′); 13 and 18 miles west of Chihuahua City (5100′, 5400′); 16 miles east of Cuauhtemoc (5900′); Bachimba (4200′); 2, 17 and 22 miles south of Parral (5500′).

DURANGO: Villa Ocampo (5700′); 22 miles south of Villa Ocampo (5700′).

Novomessor cockerelli:

NEVADA: 9 miles north of Searchlight (3200′).

TEXAS: Palo Duro Canyon (3000′).

ARIZONA: Whetstone Mountains, Dry Canyon (5000′); Plains west of the Baboquivari Mountains (3000′); Organpipe Cactus National Monument, Headquarters (1600′), Dripping Springs (1700′), Quitobaquito (900′); 25 miles east of Douglas (4000′); 20 miles east of Gila Bend (2700′); 8 miles north of Casa Grande (1300′); 7 miles east of Aguila (2200′); Safford (3000′); 15 miles north of Wilcox (4100′).

SONORA: 3 and 8 miles south of Sasabe (3400′); 2 and 10 miles south of Sonoita (1300′, 1400′); Campamto (1400′); Santa Ana and five miles south of Santa Ana (2500′); 6 miles south of Imuris (3200′); 10 miles south of Hermosillo (700′).

CHIHUAHUA: Plains east of the Sierra de en Medio (4700′); El Pueblito (4900′); 6 miles south of Gallego (5100′); 5 miles north of Ojo Laguna (4800′); 7 miles north of Chihuahua City (4700′); Jiminez (4300′); 2, 34 and 38 miles south of Parral (5500-5800′).

COAHUILA: Nava (1000′); 20 miles north of Saltillo (4000′); Sierra de la Paila (4800′); 22 miles west of Saltillo (5000′).

DURANGO: 12 miles south of Villa Ocampo (5600′); 17 miles south of Rodeo (5500′); 5 and 6 miles east of San Lucas (6100′); 17 miles south of Durango City (6400′).

ZACATECAS: 30 miles east of Sombrerete (6900′).

The table below shows the relationship of latitude to elevational range in the two species. It is based on the records just given plus about thirty older ones for which elevational data was available or could be assigned with acceptable accuracy. The numbers in parentheses are the totals of the records involved.

Latitude	Elevational Range *N. cockerelli*	Elevational Range *N. albisetosus*
36°-34°	(3) 3000-3300′	no records
34°-32°	(16) 1000-4500′	(8) 1800-5200′
32°-30°	(20) 1300-5000′	(22) 3100-5800′
30°-28°	(10) 700-5100′	(7) 2600-5900′
28°-26°	(5) 4300-5800′	(5) 5500-5700′
26°-24°	(5) 4000-6100′	no records
24°-22°	(5) 6100-7000′	no records

The following points in the above table should be noted:

1. The range of *cockerelli* extends further north and much further south than does that of *albisetosus*. There are no records for the latter species north of Latitude 34° or south of Latitude 26°.

2. The effect of latitude on the upper limit of the elevational range is different in the two species. From Latitude 34° to Latitude 26°, where they occur together, the rise in the upper elevational limit is 700 feet for *albisetosus* against 1300 feet for *cockerelli*. Over the entire range of *cockerelli* the rise is almost 4000 feet.

3. In the northern part of the common range the upper elevational limit of *cockerelli* is approximately 1000 feet below that of *albisetosus*. But because this limit rises more rapidly in the case of *cockerelli*, the two species have the same upper limit about Latitude 26°. South of that latitude the upper limit of the vertical range of *cockerelli* continues to rise, but, since *albisetosus* does not occur south of Latitude 26°, the records for *cockerelli* from stations above 6000 feet cannot properly be compared with those for *albisetosus*.

4. In the common range there is a considerable area of overlap in the vertical ranges of the two species. The two vertical ranges are never identical, however, for although the upper limits may coincide, the lower limit of *cockerelli* always descends below that of *albisetosus*. This difference is at least 800 feet and often much more.

It goes without saying that this response to elevation has a direct connection with the topography of the regions in which the two species occur. In subsequent pages the writer has discussed some of the topographic features which affect the distribution of the two species. The most extensive of these is the Sierra Madre Occidental, which determines the western limit of the range of both species for several hundred miles in northern Mexico. Most cartographers show the Sierra Madre Occidental as a continuous rampart which extends from Zacatecas northwestward to the southern border of Arizona. In the opinion of the writer it may be doubted that the highlands of Zacatecas ought to be considered as a part of the Sierra. At least they are cut off from the rest of the Sierra by the valley of the Rio Mezquital, which rises on the Plateau in southern Durango and flows westward to the Pacific. A similar gap, leading south to Aguascalientes, occurs at the eastern end of the highlands of Zacatecas. But proceeding northward from the valley of the Rio Mezquital to Latitude 30° the main chain of the Sierra presents an unbroken barrier whose crest varies between 8000 and 9500 feet. It should be noted that there are few peaks in this region and none of them are high. Nevertheless the Sierra forms an effective barrier to any species whose vertical range is below the 8000 foot level. Both *albisetosus* and *cockerelli* appear to be held to the eastern side of the Sierra until its topography changes in northwestern Chihuahua. North of Latitude 30° the Sierra breaks up into a number of scattered ranges, few of which show elevations in excess of 7500 feet. Between these ranges are broad valleys which communicate on the east with the Mexican Plateau and on the west with the narrow Sonoran coastal plain. From east to west the elevation of these valleys gradually descends from 5000 to 1000 feet. There is no barrier here comparable to the main chain of the Sierra further south and both *albisetosus* and *cockerelli* occur widely in this region. The range of *cockerelli* is, however, more extensive than that of *albisetosus*. The latter species does not descend below 2500 feet in this region, while *cockerelli* occurs at elevations down to 700 feet. It follows that *cockerelli* occasionally nests on the inner edge of the coastal plain while *albisetosus* rarely gets within fifty miles of it. The range of *cockerelli* follows the inner border of the Sonoran coastal plain as far as Quitobaquito, where it turns north through the Growler Mountains in Arizona and thence to the Gila Bend Mountains. As far as the writer could determine the insect is not present in the Gran Desierto in northwestern Sonora, nor in the mountains immediately north of it in western Arizona. Records for both species from stations northwest of the Gila Bend Mountains are scarce. The range of *albisetosus* appears to terminate near Wickenberg, that of *cockerelli* procedes into southern Nevada.

The presence of *cockerelli* in southern Nevada leads to the vexing question as to whether or not this insect occurs in California. In the writer's opinion there is no proof at present that *cockerelli* occurs west of Nevada. To date all California records for *cockerelli* are demonstrably incorrect[2] or suspect. In 1934 Cole (3) published the statement that *cockerelli* is "rather common" near Barstow, Ludlow and Tehachapi. The first two stations are on the Mojave Desert, the last one is at the southern end of the San Joaquin Valley. Although the writer doubted the Tehachapi record from the start, there seemed little reason to question the Barstow and Ludlow records until the spring of 1951. In April of that year a series of exceptionally favorable climatic conditions resulted in a magnificent display of ephemeral flowers on the Mojave Desert. This extraordinary burst of bloom (said to have been the best in a period of twenty years) was accompanied by a corresponding burst of foraging activity on the part of the ants in that area. At this time the writer was

[2] In his recent book on California ants T. W. Cook states (p. 115) that he took a colony of *N. cockerelli* on the Mills College campus at Oakland. The explanation for this record is quite simple; what Cook had was a colony of *Veromessor andrei*. There can be no doubt of this, for the three illustrations of the worker that Cook presented as that of *"Novomessor cockerelli"* are drawn from a small worker of *Veromessor andrei*. It is unpleasant to have to add that most of Cook's misguided efforts with the California ants are little better than his fumbling treatment of *cockerelli*.

collecting daily in the area between Barstow and Tehachapi. Yet not a single colony of *cockerelli* was encountered.

There seemed to be only two possibilities here. Either *cockerelli* had notably decreased in abundance in the western Mojave Desert since 1934 or Dr. Cole's records were incorrect. In the hope of clarifying this point I wrote to Dr. Cole for further information on his 1934 records. Dr. Cole replied that there were no specimens of *cockerelli* from California in his collection at present. It seems virtually certain, therefore, that the above records were based on field identification only. The writer believes that they were the result of the misidentification of abandoned nests of *Veromessor pergandei.* This ant is abundant in most parts of the Mojave Desert. It makes nests which might be mistaken for those of *cockerelli* and it often abandons them. Whether this explanation is correct or not, it should be clear that at present there is no reliable evidence to show that *cockerelli* occurs in California. If it does so, it seems certain that its occurrence in that state will be limited to the eastern end of the Mojave Desert. In the writer's opinion it is safe to conclude that none of the range of *cockerelli* lies west of Longitude 115° and only a very small part of it lies west of Longitude 114°.

The northern limit of the range of both *cockerelli* and *albisetosus* seems largely determined by the inability of either species to occupy highland areas in northern and central Arizona and New Mexico. Southeast of Wickenberg, Arizona, the range of both *cockerelli* and *albisetosus* runs along the southern end of the region where the rise to the Mogollon Mesa begins. This area is much broken up by valleys and canyons and it seems certain that the northern limit of the range is much more irregular in this area than our present records indicate. For most of these have come from the easily accessible southern end of the area. The Mogollon Mesa itself forms an effective northern barrier, for its elevation is too great to permit either *cockerelli* or *albisetosus* to reach the top of the plateau. In eastern Arizona and western New Mexico the limit of the range dips even further to the south, passing below the southern end of the Blue Mountains in Arizona and the Black Range in New Mexico. Further east in New Mexico the range swings north again in the Rio Grande Valley and the Tularosa Valley. The range in southeastern New Mexico is at present conjectural, for there are no published records for New Mexico east of Alamogordo. But the presence of *cockerelli* in Palo Duro Canyon in the Texas Panhandle makes it seem likely that the range runs northeastward through the Staked Plain region.

The eastern boundary of the range of *albisetosus* is very little known but it seems safe to say that it does not coincide at all with that of *cockerelli*. The easternmost record for *albisetosus* to date seems to be the colony which the writer took in 1933 at Cernas Ranch in the Chisos Mountains of Texas. This station lies about ten miles west of Longitude 103°. The Chisos Mountains are so close to the Sierra del Carmen and the Serranias del Burro in northern Coahuila, that *albisetosus* can scarcely be absent in the Mexican ranges. But that it extends far south in Coahuila seems very doubtful. We failed to take it in the Sierra Hermosa de Santa Rosa, a small range which lies just south of those previously mentioned. Neither was *albisetosus* secured in the mountains around Saltillo, although *cockerelli* was taken there. Since the collections around Saltillo were carried up to the 7200 foot level, the vertical range of *albisetosus* was more than covered. It is hard to see why the insect should be absent in the mountains of southern Coahuila, but this appears to be the case.

The eastern boundary of the range of *cockerelli* is much better known. There are at present seven records extending from Palo Duro Canyon, Texas (Lat. 35°), almost to Saltillo, Coahuila (Lat. 26°). Six of these records are within twenty-five miles of Longitude 101°, the seventh is only ten miles west of Longitude 102°. This comparatively smooth eastern boundary is certainly not determined by topography. Two of the stations are on the Edwards Plateau, three in the Rio Grande Valley and two in the mountains of southern Coahuila. Since *cockerelli* can occur in the Rio Grande Valley at elevations of 1000 feet (Del

Rio, Texas, and Nava, Coahuila) the writer fails to see why it has not been taken in northern Nuevo Leon. North of Monterrey are a number of mountains which rise from a base plain about 1400 feet high. The valleys between these mountains seem ideal for *cockerelli* and the writer feels sure that it will ultimately be taken there.

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OBITUARY NOTICE

Professor Charles T. Brues, for many years an active member of the Cambridge Entomological Club and Editor of PSYCHE for thirty-seven years, died at his home in Crescent City, Florida, on July 22, 1955. A future issue of PSYCHE will contain a biographical account of Professor Brues and a list of his publications.

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THE IDENTITY OF *MACROCEPHALUS BIDENS* OLIVIER, 1795, WITH A REVIEW OF THE GENUS *TOXONOTUS* LACORDAIRE (COLEOPTERA: ANTHRIBIDAE)[1]

By Barry D. Valentine

Mississippi Southern College, Hattiesburg

Recently, while checking the descriptions and figures of Anthribid weevils in Olivier's Entomologie, my attention was drawn to an unfamiliar name. A check of some other important anthribid literature revealed that in the one hundred and fifty-nine years since Olivier's description and figures were published, the name, *Macrocephalus bidens*, has vanished from the pertinent anthribid literature of the world with the single exception of Schönherr's Genera et Species Curculionidum, where in volumes one and five (1833, 1839) it is listed in *"incerti generis, species mihi invisae"*. It is not mentioned in Lacordaire (1866), Bovie's catalogue (1906), Wolfrum's paper on West Indian anthribids (1930), the anthribid portion and supplement of the Coleopterorum Catalogus (Wolfrum, 1929, 1953), or Blackwelder's catalogue (1947).

Actually, *Macrocephalus bidens* Olivier should not be dropped from the lists, for it is a recognizable species. It is restricted to this hemisphere by its type locality "Saint Domingue" which has gradually changed through Saint Dominique, Santo Domingo, and Dominican Republic, and at the time of Olivier's description, referred to all, or part, of the island of Hispaniola. Once a Caribbean locality is established, the description and figures characterize *bidens* as having a short, wide rostrum, three transversely arranged "tubercles" on the disc of the prothorax, more "tubercles" on the elytra, and very hairy legs. This combination of features immediately rules out all New World genera except *Neanthribus* Jordan and *Toxonotus* Lacordaire. The two genera in question both occur on His-

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[1] Published with a grant from the Museum of Comparative Zoology at Harvard College.

paniola; however, Olivier mentions nothing which might help to decide between them. The two are differentiated by the presence of a tarsal spine, long male antennae, and emarginate eyes in *Toxonotus,* while *Neanthribus* has no tarsal spine, short male antennae, and truncate eyes. Of these, the tarsal spine is not visible on the plates, but neither was it mentioned in the original description of the generitypic species of *Toxonotus, T. fascicularis.* As a matter of fact, it was not mentioned at all until 1866, thirty-three years after Schönherr's description of *fascicularis,* and seventy-one years after the description of *bidens.* The antennae, as figured, could be those of *Neanthribus* or a female *Toxonotus,* and the eyes are so poorly illustrated that it is difficult to be certain of their shape, although one gets the impression that they might be entire. Since there are no diagnostic generic criteria available, the only recourse is to attempt identification of the species *bidens* itself. The written description is again useless, but Olivier's plate shows a unicolored brownish insect, with the exception of the pale declivity of the elytra, paler head, and slender, hairy, red legs. I know of no *Neanthribus* species which fits this description; however, a few weeks ago, I gave a manuscript name to a species of *Toxonotus* from Hispaniola which, at the time, I thought was undescribed, and which matches this color scheme perfectly. I haven't the slightest doubt that this species is, in reality, Olivier's *bidens,* and it should therefore be known as **Toxonotus bidens** (Olivier), new combination.

In order to avoid any possibility of confusion, the following review of *Toxonotus* is presented.

Genus *Toxonotus* Lacordaire, 1866

Toxonotus Lacordaire, 1866, Gen. Coleop. vol. 7, p. 575. Generitype: *Anthribus fascicularis* Schönherr, 1833, by original designation and monotypy.

As far as known, this is the only genus in the world fauna which has a long, slender spine on the dorsal, apical margin of all first tarsal segments. This spine extends half-way over the second segment, and is sometimes partially obscured by long pubescence. To my knowledge, there is only one other anthribid which ever has a spine on the first tarsal segment. It occurs in some males of *Piesocorynus mixtus* Leconte; however, in this species the spine, when present, is on the ventral surface, and is usually subapical in position. The genus is further characterized as follows: rostrum and interocular area with a median carina which is interrupted by a deep, sharply limited pit located opposite the lower limit of the eyes; transverse carina of prothorax basal, fitting against the biconvex basal margin of the elytra; dorsal surface of the prothorax and elytra ornamented with tufts of erect pubescence and a lateral fringe; tibiae with long, erect, pale pubescence giving a bottle-brush effect; tarsi with the above-mentioned spine on the first segment, and the third segment not conspicuously dilated into a broad pad, the lobes free, not conate; antennae of males three-fourths to one and one-half times the total length of the body, of females up to one-half the length of the body; eyes with the margin adjacent to the antennal scrobes strongly emarginate.

The relationships between *Toxonotus* and the related genera *Neanthribus, Phoenicobiella,* and *Platystomos* are extremely complex. It is evident from a study of all four genera and many species that three distinct evolutionary lines are present, plus several connecting forms. The three lines are climaxed by *Platystomos* in the Old World, and *Neanthribus* and *Phoenicobiella* in the New, with such forms as the two *Toxonotus* species and "*Neanthribus*" *lividus* Lec. and *trituberculatus* Suffr. as the intermediate links. There are several other intermediate forms also, but it is not my intention to discuss them here; at least one is still undescribed, and the subject will be covered in detail in a generic revision of the North American fauna soon to be ready for publication. I have mentioned this complex now only so that other coleopterists familiar with the group might see the problem too, and perhaps lend pertinent material, for I particularly need Antillean specimens and exotic *Neanthribus* and *Platystomos* species. As a matter of fact, even locality records and biological data for United States species would help considerably in deciphering the complex zoogeography and relationships.

The species described as *Toxonotus trituberculatus* Suffrian, 1870, has been transferred to *Neanthribus* by Wolfrum (1930). Judging by Suffrian's description, the species properly belongs in *Phoenicobiella* or in a new genus. It is obviously one of the key species in the intergrading generic complex mentioned above. The two remaining species of *Toxonotus* can be distinguished by the following key and short diagnoses.

1. Apex of prothorax with two patches of extremely dense, pale, brown pubescence, one on either side of the median line; elytral pubescence striped, even-numbered interspaces bluish gray, odd-numbered ones brown or brown flecked with white ....*Toxonotus fascicularis* (Schön.)
2. Apex of prothorax without patches of denser pubescence, instead with two short, curving, white lines; elytral pubescence not striped, brown to brownish gray .... *Toxonotus bidens* (Olivier)

Toxonotus fascicularis (Schönherr)

Anthribus fascicularis Schönherr, 1833, Genera et Species Curculionidum 1(1) :132. Type locality: Cuba.

Integument dark brown to black except for antennae, apices of femora, tibiae, and tarsi which are paler. Pubescence very short; on prothorax variegate with gray and brown, two large patches of dense pale brown extending from lateral discal tufts to apex; on elytra sparse, striped with gray and brown as mentioned in key, sometimes with first three interspaces heavily dusted with white, declivity with a sharply contrasting, dense white patch which attains the apical margin only along the suture, this sutural connection sometimes partially or completely interrupted; on metasternum gray to white. Antennae with segments 11, 10, and the distal portion of 9 dark brown to black, contrasting sharply with the remainder which is gray.

This species ranges throughout southern Florida and Cuba. The northernmost locality known to me is Enterprise, Volusia County, Florida. Two hundred and eight specimens examined; of these, two from Baragua, Cuba, were colleced at light by L. C. Scaramuzza in May. No other biological data available.

Toxonotus bidens (Olivier) new combination

Macrocephalus bidens Olivier, 1795, Entomologie, vol. 4, genus no. 80, p. 14, Pl. 2, fig. 18a, b. Type locality: Saint Domingue.

Identical with *T. fascicularis* (Schön.) with the exception of the color and vestiture. Integument varying from dark red to a startlingly clear, pale red, the latter especially on the appendages. Pubescence long and coarse, appearing shaggy and unkempt beside the trim-looking *T. fascicularis;* on prothorax unicolored brown, with no dense apical patches; instead with two arcuate lines of coarse white bristles which originate just laterad of each of the two small apical tufts, and run posteriad for a short distance before curving laterally and ending midway between the lateral discal tufts and the pronotal apex; on elytra pale brown to almost gray, not conspicuously striped, apical declivity with coarse, dirty white bristles, slightly denser than elsewhere, but not short as in *fascicularis*, and not sharply demarcated; on metasternum dirty yellow. Antennae unicolored gray, the last three segments not contrasting sharply with the remainder.

Three specimens known to me; a pair in the Museum of Comparative Zoology, the male labeled, "Ennery, Haiti, nr. 1000 ft., Sept. 6-11, 1934, (Darlington)", the female simply, "S. Dom.", and the third, of undetermined sex, in the American Museum of Natural History labeled, "San Lcrenzo [sic], R. Dom. vi-27-29-15". The M.C.Z. female is considerably paler than the other two specimens. Its clear red, hairy legs leave an indelible impression.

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1930. Uber Anthribiden von Cuba und dem grossen Antillen (Col.). Deutsch. Ent. Zeitsch. **1930**: 25-32.
1953. Anthribidae. Coleopterorum Catalogus Supplementa. Pars **102**: 1-63.

THE ANT CENTROMYRMEX DONISTHORPEI MENOZZI, A SYNONYM. — Menozzi described *Centromyrmex donisthorpei* in 1925 (Philippine Jour. Sci., 28:443, pl. 1, figs. 4a, 4b, female) from two specimens. One of these, here designated as lectotype, is from Iligan, Mindanao, and is now on deposit in the Museum of Comparative Zoology. While slightly darker than the average specimen of *Centromyrmex feae* (Emery) (1889, Ann. Mus. Civ. Stor. Nat. Genova, 27: 491, pl. 10, figs. 11-15, worker), originally cited from Burma, I can detect no taxonomically important differences between it and female specimens (alate and dealate) taken with workers of the common *C. feae* at several widely separated southeast Asian localities. A **new synonymy** is indicated. — W. L. BROWN, JR., Museum of Comparative Zoology.

A GYNANDROMORPH OF *MELANOPLUS MEXICANUS MEXICANUS* (SAUSSURE) EXTREME MIGRATORY PHASE (ORTHOPTERA: ACRIDIDAE)[1]

By H. C. Severin

South Dakota State College, Brookings, South Dakota

The gynandromorph described in this paper was loaned the author by Dr. Roscoe E. Hill, Chairman of the Department of Entomology, University of Nebraska. The specimen was taken from the collections of the University of Nebraska State Museum and was returned to the Museum of that University. The specimen was collected at or near Pine Ridge, Nebraska, in July. No further definite data regarding the origin of the specimen was available such as year when the specimen was collected or the name of the collector. For purposes of comparison the author of this paper borrowed from the Nebraska State Museum through Dr. Hill a normal male and a normal female specimen of *Melanoplus mexicanus mexicanus* (Saussure) *Extreme Migratory Phase.* These specimens were collected at or near West Point, Nebraska. Neither of these specimens had a date label attached to them but one of the specimens had a label attached to it with the following data printed in ink, by hand: *Melanoplus spretus* Thos. (Det. L. Bruner).

Since the gynandromorph and the borrowed male and female grasshoppers were apparently old, it is reasonable to believe that Professor L. Bruner might have been the collector not only of the normal grasshopper but of the

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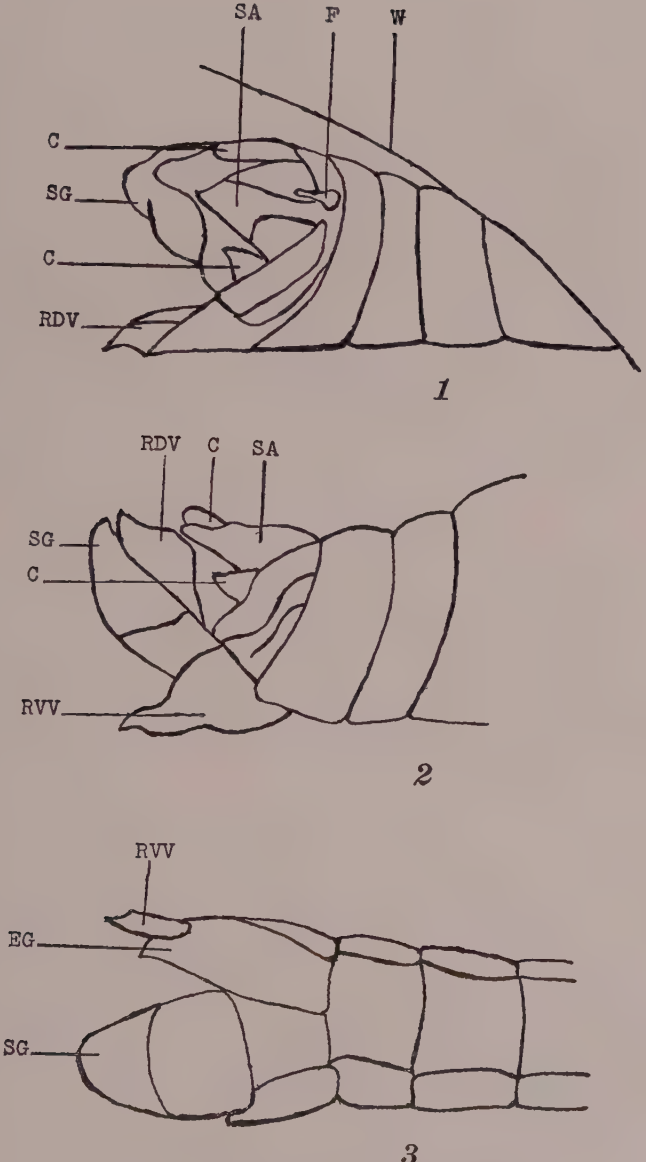
[1] Approved for publication by the Director of the South Dakota Agricultural Experiment Station as Journal Series No. 322.

EXPLANATION OF PLATE 10

1. Dorsal view of posterior part of abdomen; 2. lateral aspect of right side of posterior part of abdomen; 3. ventral view of posterior part of abdomen. C. cercus; EG, egg guide; F, furculum; RDV, right dorsal valve of ovipositor; RVV, right ventral valve of ovipositor; SA, supra-anal plate; SG, subgenital plate; W, margin of tegmen.



Severin — Melanoplus mexicanus mexicanus gynandromorph as well. The author wishes to thank Dr. Hill for the privilege of studying the grasshoppers loaned him.

Melanoplus mexicanus phase *spretus* (Walsh) is regarded by most entomologists as a phase of *Melanoplus mexicanus mexicanus* (Saussure) and is looked upon by most Orthopterists as the Rocky Mountain Locust which was so prevalent and destructive in the United States from 1862 to 1876.

The author of this paper described a gynandromorph of *Melanoplus mexicanus mexicanus* (Sauss.)[2] but this description of the morphology is quite different from the description of the gynandromorph of *M. m. mexicanus* (Sauss.) *Extreme Migratory Phase* presently to be described.

Description of the Gynandromorph of *M. m. mexicanus* (Sauss.) Extreme Migratory Phase.

This gynandromorph is typically female in structure including the body morphology and the appendages except for the posterior end of the abdomen which is typically male in the left half and mostly typically female in the right half.

The lateral carinae of the fastigium of the head, are not prominent and the fastigeal depression is shallow. These characters are typical of normal female specimens. The interocular space is wide as in normal female specimens.

The tubercle on the mesosternum, which is very well developed in normal male specimens and only faintly indicated or entirely absent in normal females, is lacking in the gynandromorph. The femora and tibiae of the first two pairs of legs of the gynandromorph are less heavily constructed than in the normal males and in this respect resemble the femora and tibiae of typical females. The arolia of the tarsi of the gynandromorph are small and resemble those of a normal female.

The left half of the posterior end of the abdomen is typically male in structure with very little distortion. The right half, however, is female with some distortion. A normal appearing upper and lower valve of an ovipositor are present on the right side. The right cercus is female in shape, while the left resembles the cercus of a male. The furculum on the left side is absent while on the right it is present and resembles in size and shape the furculum of the typical male. The supra-anal plate is bilaterally symmetrical and resembles rather closely the supra-anal plate of a male except for a transverse ridge extending across the right half of it. A subgenital plate is present but only the left half is developed. Consequently the terminal notch present in normal males is lacking in this gynandromorph. On the right side a terminal abdominal sternite resembling one-half of the end sternite of a female abdomen is present. Even one-half of the so-called egg-guide terminates this sternite (see figures 1, 2, 3).

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[2] Severin, H. C. 1943. A Study of a Gynandromorph of *Melanoplus mexicanus mexicanus* (Sauss.) (Orthoptera) 1943. Journal of New York Entomological Society Vol. LI., pp 179-183.

REVISIONARY NOTES ON THE SANGUINEA AND NEOGAGATES GROUPS OF THE ANT GENUS FORMICA[1]

By E. O. Wilson and W. L. Brown, Jr.

Harvard University

In recent years, specialists engaged in ecological and regional studies of North American ants have repeatedly called upon us to check species identification against types and other "historic" material in the Museum of Comparative Zoology (MCZ). The specialist working away from such a collection is likely to assume that the difficulty can readily be cleared up by mere comparison of his fresh material against the Museum series; unfortunately, such comparison by itself rarely produces satisfactory results. Of the groups arriving at the MCZ, one causing repeated difficulty is the so-called subgenus *Raptiformica* of *Formica.* In many ways, it exemplifies the current taxonomic conditions within many of our commonest groups of ants.

The principal fault of the accepted *Raptiformica* arrangement lies in an excessive unrecognized synonymy, which in turn stems from past failure to appreciate the extent of allometric and other normal expressions of intraspecific variation. Species such as *pergandei* and *rubicunda* have been founded in large part on supposed differences in head shape, but closer examination shows these and other cases to be nothing more than size variants along the same general allometric gradient. Trivial variations in pilosity, sculpturing, and color have also been much overworked in separating "species"; examination of enough material soon reveals most such variation as continuously intergradient and broadly bridging the old gaps.

Another situation bound to give continuing trouble in the future concerns the elusiveness of presumed sibling species such as *F. parcipappa, F. curiosa* and *F. wheeleri* —

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[1] Published with a grant from the Museum of Comparative Zoology at Harvard College.

we have been unable to find reliable and convincing characters marking the worker caste of these three forms. We are keenly aware that lack of material may have caused us to overlook other full but more or less cryptic species.

The original and present goals of this study are the elimination through synonymy of those names which cannot be supported by all available evidence, correction of certain inconsistencies in previous revisions (see literature cited at end of paper), and construction of a new key based on the present revision. After the majority of the work had been completed, however, another important consideration arose.

It had become apparent early in the task that *Raptiformica* included two species-groups, termed by us respectively "*sanguinea* complex" and "*obtusopilosa* complex."

The *sanguinea* complex is distinguished by the following assemblage of characters:

(1) The workers of all of the species usually have the gasters black and the remainder of the body red, except *F. parcipappa,* which is concolorous reddish yellow.

(2) The workers average large in size for *Formica,* are robust, and have a well-defined metathorax.

(3) The propodeum is short, with a well-defined angle, and the petiolar scale is high and thin.

(4) The gastric pubescence is dense and the body pilosity generally sparse. Hairs are never present on the dorsal face of the propodeum anterior to the propodeal angle.

(5) The sculpture is generally opaque, or at most rather weakly shining.

(6) The male has relatively broad parameres and a subgenital plate of a particular conformation (figs. 3, 5).

(7) All of the species take slaves, at least facultatively, except *F. parcipappa,* which is known only from limited cabinet material.

(8) The complex as a whole prefers mesic habitats.

The *obtusopilosa* complex, perhaps wrongly named at the outset because *obtusopilosa* is the least typical and most poorly known of the species, offers the following characters:

(1) The worker coloration shows much interspecific variation, ranging from concolorous yellowish red to concolorous black or red and black.

(2) The workers average smaller in size than in the *sanguinea* complex, are more slender in body form, and have a poorly defined metanotum.

(3) The propodeum is proportionately longer and more rounded, with little or no angle between dorsum and declivity.

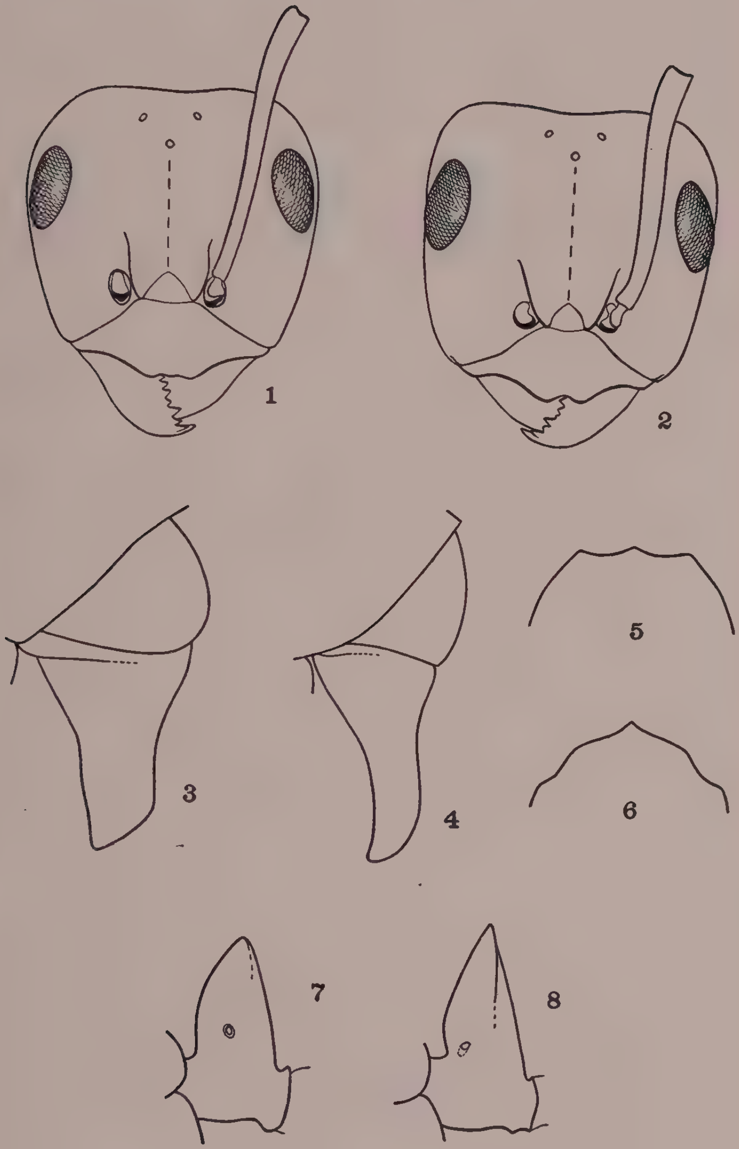
(4) The gastric pubescence is very sparse (except in *obtusopilosa*) and the body pilosity generally abundant. Hairs are usually present, and often abundant, on the dorsal face of the propodeum anterior to the propodeal angle.

(5) The sculpture is usually feeble and the integument therefore more shining.

(6) The male has relatively slender parameres and a subgenital plate of a distinctive conformation (figs. 4, 6).

EXPLANATION OF PLATE 11

Fig. 1. Head of *F. subintegra* worker from University of Michigan Biological Station, Douglas Lake, Cheboygan Co., Mich. (P. B. Kannowski). Head width 1.71 mm. Fig. 2. Head of putative *F. curiosa* worker from Culbertson, Roosevelt Co., Mont. (E. O. Wilson). Head width the same as in *subintegra* specimen of fig. 1. Fig. 3. Left paramere of *F. subnuda* male from Woodland Park, Teller Co., Colo. (W. M. Wheeler). Fig. 4. Left paramere of *F. perpilosa* male from Ft. Davis, Texas (W. M. Wheeler). Fig. 5. Posterior border of subgenital plate of same specimen as in fig. 3 (*F. subnuda*). Fig. 6. Posterior border of subgenital plate of same specimen as in fig. 4 (*F. perpilosa*). Fig. 7. Left side view of petiole of *F. subintegra* worker from Rogers City, Presque Isle Co., Mich. (P. B. Kannowski). Head width 1.63 mm. Fig. 8. Left side view of petiole of *F. subnuda* worker from Kiowa, Glacier Co., Mont. (E. O. Wilson). Head width 1.76 mm.



WILSON AND BROWN — FORMICA

(7) So far as is known, none of the species ever take slaves.

(8) The complex as a whole is limited mostly to xeric habitats in western North America.

The only species placed in the *obtusopilosa* complex with reservations is *obtusopilosa* itself. In body form, pilosity, ethology, and habitat preference, it resembles the rest of the complex. But it also possesses coloration and gastric pubescence characteristic of the *sanguinea* complex. The male genitalia could add weighty and possibly decisive evidence, but unfortunately no *obtusopilosa* males seem to be available in any collection at the present time.

Both complexes share the clypeal notch character diagnostic of *Raptiformica,* although in general this seems better developed in the *sanguinea* complex. Despite the presence of the notch, we felt that the two groups were very discrete from one another, casting doubt on the validity of *Raptiformica* as a natural grouping. At a late moment, we were led by a chance remark by Dr. Creighton (*in litt.*) to reconsider certain views expressed to us in an all-but-forgotten letter received in 1953 from Dr. W. F. Buren. Buren's opinion then was that synonymy should bracket no less a pair of forms than *Formica* (*Raptiformica*) *bradleyi* Wheeler and *Formica* (*Proformica*) *neogagates* var. *morbida* Wheeler. Further, Buren implied that the taxonomic standing of *Raptiformica* and the Nearctic representatives of *Proformica* is due for reconsideration in the light of this synonymy[2].

Checking the type material involved in this important finding, we can only agree with Buren's suggested synonymy, which certainly will have a far-reaching effect in the simplification of the taxonomy of the genus *Formica.* We are not prepared to enter extensively into the taxonomy of the "*Proformica* complex" at this time, but a few of our observations bearing on group interrelationships are offered as follows:

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[2] See Acknowledgements at the end of this paper.

(1) In habitus of all castes of both sexes, and in details of worker-queen sculpture, pilosity, and form of propodeum and petiole, members of the *obtusopilosa* complex and the Nearctic species of *"Proformica"* (*neogagates* group) are obviously similar.

(2) The diagnostic *Proformica* character involving proportions of the first three funicular segments, never a very happy distinction, appears to grade through in the *sanguinea-obtusopilosa* series.

(3) The clypeal notch, supposedly characteristic of *Raptiformica,* is as well (or better) developed in many *F. neogagates* specimens as it is in those of some species customarily placed in *Raptiformica* (e. g. *bradleyi,* or even *subnuda*). The notch in *neogagates* and *bradleyi* is more properly described as a "vaulting" of the median clypeal margin as seen from an adoral view, but the effect is the same from full-face view, and the difference from the condition of *subnuda* is trifling, not to say academic. In *neogagates,* which appears to be a species distinct from *bradleyi* (= *morbida*) on the basis of color and pilosity characters, variation in clypeal vaulting is considerable. Most western samples show stronger vaulting, frequently equalling *bradleyi,* while some eastern samples have a flattened border like that of *lasioides.*

(4) The parameres and subgenital plate of the male in *neogagates, bradleyi,* and *perpilosa* are very similar (see figs. 4, 6).

(5) Many of the Palaearctic species of *Proformica,* including the subgeneritype *F. nasuta* Nylander, differ markedly from the Nearctic species (typified by *neogagates*) in characters involving degree of worker polymorphism, and in worker-queen mandibular dentition. In addition, the male genitalia are very distinctive in the one species, *nasuta,* in which males have been examined. These species seem to form a monophyletic group easily separated from the Nearctic *neogagates* group as well as from all Nearctic *Formica.*

Conclusions drawn from these facts are: (1) the *obtu-*

sopilosa complex is closest to, in fact coextensive with, the *neogagates* group (= Nearctic "*Proformica*") and probably has no direct connection with the *sanguinea* group; (2) the *neogagates* group, including the *obtusopilosa* complex, should be transferred to *Formica s. str.;* (3) unless species annectant to *Formica* or *Cataglyphis* can be demonstrated, the true *Proformica* of the Old World, with *nasuta* as its type, probably rates full generic rank; (4) the subgeneric name *Raptiformica,* having lost its morphological associations, should be put into synonymy until evidence is forthcoming for the need to recognize more than "species groups" in *Formica.*

The changes discussed in this work as they affect the old "Raptiformica" complex are outlined in the following synopsis. In this paper, only new synonymy will be cited formally; for additional synonymy and other references, see Creighton, 1950, pp. 460-472. The treatment of the *sanguinea* group here together with the *obtusopilosa* complex no longer implies natural connection between these two assemblages of species.

sanguinea group

curiosa Creighton
parcipappa Cole
sanguinea Latreille (with "varieties")
subintegra Emery
    = *pergandei* Emery (n. syn.)
    = *puberula* Emery (n. syn.)
    = *rubicunda* Emery (n. syn.)
    = *sublucida* Wheeler (n. syn.)
subnuda Emery (n. status)
    = *emeryi* Wheeler (n. syn.)
wheeleri Creighton

obtusopilosa complex of *neogagates* group

bradleyi Wheeler
    = *neogagates* var. *morbida* Wheeler (n. syn., W. F. Buren *in litt.*)
manni Wheeler
    = *oregonensis* Cole (n. syn.)

obtusopilosa Emery
= *obtusopilosa alticola* Wheeler (n. syn.)
perpilosa Wheeler

SPECIES IN THE SANGUINEA GROUP PROPER

In our study of *sanguinea* and relatives, we have been engaged chiefly with the Nearctic forms. It will be noticed that where Creighton recognized ten Nearctic species in the true *sanguinea* group, we retain only half that number, and of these five names, we can recognize only two as representing solidly verified and distinct species: *subintegra* and *subnuda*. The three forms *curiosa, parcipappa* and *wheeleri* were all described from very limited material, and all are close to, if not synonymous with, the extremely variable *subintegra*. All three are western in distribution, and significantly it is in the west that *subintegra* reaches its peak variability, in an area where a wide range of differing habitats is available to influence variation. It is also possible that these slave-makers respond in some way to the characteristics of the available slave species of *Formica,* which in general are more diverse in the western part of North America.

As work on the *sanguinea* group progressed, we solicited the aid of several of our North American colleagues with respect to problems met. While comments and material received in the ensuing exchange were often very helpful, we have been surprised at the vigor of the opposition aroused by some of our synonymic proposals. Unfortunately, the evidence for such opposed viewpoints did not match the conviction with which they were sometimes expressed. Despite requests on our part for further particulars, we have received no evidence to indicate that anything is amiss with our synonymy. We are assuming that all important relevant data have now been forwarded for our consideration in the preparation of this paper.

The couplet offered below will serve to separate workers of *subnuda* from those of *subintegra.*

A. Gula completely bare of standing hairs in all of the workers of a nest series; dorsal petiolar margin completely lacking hairs, or at most with one or two inconspicuous hairs less than 0.03 mm in length; hairs almost never present on propodeum; petiolar scale in side view nearly always thin and with a sharp crest (see fig. 7). (Boreal-alpine North America) .... *subnuda* Emery

B. At least one or two long, coarse, standing hairs normally present on the gula of a majority of the workers of a nest series; in those individuals with pronotal width of 1.0 mm or greater, and frequently in all of the nest members, the dorsal petiolar margin bears at least two or three hairs 0.05 mm or more in length; hairs frequently present on the propodeum at the junction of the dorsal and declivitous faces; petiolar scale in view usually relatively thicker and with a blunt crest (see fig. 8). (Widespread in temperate N. America) .... *subintegra* Emery

For comments dealing with the separation of *curiosa, parcipappa,* and *wheeleri* from *subintegra,* see the discussions under the individual species headings below.

Formica sanguinea Latreille

Formica sanguinea Latreille, 1798, Essai Fourmis France, pp. 37-38; worker (widely distributed in temperate Eurasia).

We have had the opportunity to examine large numbers of series of this species from over most of its range. We have found it to differ with reasonable consistency from the cognate Nearctic species *subnuda* in the following worker characters:

(1) The clypeal notch is much deeper in *sanguinea.* The section of the clypeal margin enclosing the notch appears moderately concave when the head is viewed in perfect full face (at maximum length); in *subnuda* it usually appears flat or feebly convex.

(2) The body hairs are longer and more abundant in *sanguinea.* At least four or five standing hairs project

beyond the dorsal margin of the pronotum seen from the side; in *subnuda* at most three or four are visible in this view, and usually less.

(3) The head of *sanguinea* is always infuscated, and on the average more deeply than in *subnuda,* although there is some amount of overlap in the total variation of the two species.

Despite the completely allopatric distribution of *sanguinea* and its obvious cognate relationship to *subnuda,* we are treating the two forms as distinct species. The reason is that they differ by at least two discontinuous characters, while the total morphological difference is apparently greater than that separating some of the sympatric Nearctic species. Thus, in the absence of direct evidence concerning their status, reliance is placed on an arbitrary, morphological "species-standard" method in order to insure uniformity of treatment throughout the species group.

The intermediate position of *sanguinea* between *subnuda* and *subintegra* with respect to the pilosity and clypeal notch characters described above may represent another case of the phenomenon of "character displacement" as recently described in the genus *Lasius* by Wilson (1955). Our interpretation would be that *subnuda* remains well segregated morphologically from *subintegra* because it is partly sympatric with it, and as a result the two species tend to occupy ecologically different "niches." As a distinct species and the Palaearctic equivalent of *subnuda, sanguinea* has no such competitor, and therefore presumably converges morphologically toward *subintegra* in filling the adaptive vacuum which a companion species might otherwise occupy.

We have made no attempt to treat the Palaearctic "varieties" of *sanguinea* in the present study. Most of these are based on color differences and do not seem on cursory examination to be strong candidates for species rank. We have included in our diagnosis of *sanguinea* varietal material from the following several localities: Guadarrama, Spain (C. Schramm leg.; var. *flavorubra*

Forel, det. W. M. Wheeler); Lake Sevan, Armenian S. S. R. (F. Arnoldi leg.; var. *clarior* Ruzsky, det. Arnoldi and B. Finzi); neighborhood of Kiev (W. Karawajew leg.; "var. *clara*" Karawajew, ms?); "Ussurigebiet", Soviet Maritime Territory (var. *orientalis* Ruzsky, det. Karawajew); Kedzovajapadj, near Vladivostok (N. Kusnezov leg.; var. *clarior* Ruzsky, det. Kusnezov).

Formica subnuda Emery (figs. 3, 5, 8)

Formica sanguinea rubicunda var. *subnuda* Emery, 1895, Zool. Jahrb. Syst., 8: 335; worker. Type locality: Yale, British Columbia.

Formica sanguinea subnuda, Wheeler, 1913, Bull. Mus. Comp. Zool. Harv., 53: 409. Creighton, 1950, Bull. Mus. Comp. Zool. Harv., 104: 469.

Formica emeryi Wheeler, 1913, Bull. Mus. Comp. Zool. Harv., 53: 419; worker, queen. Type locality: Broadmoor, Colorado Springs, Colo. NEW SYNONYMY.

This is the most boreal and widespread of the North American members of the *sanguinea* group. Its affinity to the Palaearctic *sanguinea* is evidenced by the form of the petiolar scale, pilosity, body coloration, and degree of intranidal size variation, as well as its similar ethological characteristics. The characters which separate the two species have already been presented in the section on *sanguinea*, above. *F. subnuda,* like *F. sanguinea,* is only facultatively a slave-maker. Even when taken, the slaves frequently form only a small percentage of the nest population, (Wheeler, "Ants," p. 454; Creighton, 1950, p. 469).

A single worker and three queens from the *emeryi* type series that we have examined conform to *subnuda* in critical pilosity characters. Other differences advanced by past authors as diagnostic for *emeryi* have proven to be worthless. To avoid future confusion these are discussed in some detail below.

(1) *Emeryi* has been distinguished from *subnuda* (by Creighton) on the contention that in the largest workers the eyes extend to the margin of the head seen in full

face. As previously noted, this is a character subject to strong allometric variation. The *subnuda* types we have examined in the same size class as the *emeryi* syntypes (head widths 1.41 — 1.64 mm) exhibit the same head shape and eye placement, and this also holds for other *subnuda* series.

(2) Wheeler and Creighton both have distinguished *emeryi* from *subintegra* (= *pergandei*) by the presence in *emeryi* of a shallow transverse groove on the dorsal propodeal face of the worker. In this case the wrong pair of species was being compared, but the character must also be considered with reference to *subnuda.* Of the four *subnuda* syntypes we have examined, three possess the character and one lacks it. Other *subnuda* and *subintegra* series show the same strong intrandidal variation, and we are of the opinion that the propodeal impression is either an ecophenotypic character or else an artifact produced by warping when the specimens were first dried out. In any case, it is not diagnostic.

(3) The genal borders of the *emeryi* syntype are nearly straight, and where they meet the curved occipital border near the lower margin of the eye a weak concavity is produced. This is not so common a feature of *subnuda,* but is nevertheless within the normal range of variation for the species. One specimen of a series from Magnolia, Mass., shows the "*emeryi*" contour on one side and the typical *subnuda* contour on the other.

(4) The *emeryi* worker and queen syntypes actually differ the most from average *subnuda* in a character not mentioned by previous authors. The petiolar scale in side view is unusually thick for *subnuda,* approaching the usual *subintegra* condition, but even this is still within the range of continuous variation of *subnuda* as we conceive of that species.

F. subnuda definitely has a more boreal distribution than does *F. subintegra,* though the ranges of the two species come into close contact and even overlap in regions such as eastern Massachusetts, part of Michigan, and in widespread areas in the Rocky Mountains. The northern distribution brings *subnuda* into broad contact with *Formica neorufibarbis,* which frequently is pressed into slavery.

Formica subintegra Emery (figs. 1, 7)

Formica sanguinea var. *subintegra* Emery, 1893, Zool. Jahrb. Syst., 7: 648; worker. Type locality: District of Columbia.

Formica subintegra Creighton, 1950, *op. cit.*, p. 470.

Formica pergandei Emery, 1893, *op. cit.*, pp. 646-647; worker. Type locality: District of Columbia. NEW SYNONYMY.

Formica sanguinea rubicunda Emery, 1893, *op. cit.*, pp. 647-648; worker, queen. Type locality: Pennsylvania. NEW SYNONYMY.

Formica rubicunda, Creighton, 1950, *op. cit.*, p. 468.

Formica sanguinea puberula Emery, 1893, *op. cit.*, p. 648; worker. Type locality: Hill City, South Dakota. NEW SYNONYMY.

Formica puberula, Creighton, 1950, *op. cit.*, p. 468.

Formica sanguinea rubicunda var. *sublucida* Wheeler, 1913, Bull. Mus. Comp. Zool. Harv., 53: 408; worker. Type locality: Stony Brook Reservation, near Boston, Mass. NEW SYNONYMY.

Formica sublucida, Creighton, 1950, *op. cit.*, p. 471.

Formica sanguinea subintegra var. *gilvescens* Wheeler, 1913, *op. cit.*, pp. 412-413; worker. Type locality: Tuckahoe, New York.

The involved synonymy under *subintegra* has been the principal source of difficulty in the taxonomy of the *sanguinea* group. Myrmecologists in recent years have wasted untold amounts of time trying to distinguish species, the types of which represent nothing more than trivial infraspecific variants. The characters on which these species were based have been greatly exaggerated by both the original describers and subsequent reviewers.

Rubicunda is probably the most often used of the names considered herein as junior synonyms. Several characters have been advanced at different times and by different authors in an attempt to separate this form. The merits of each are discussed below.

(1) *Rubicunda* is said to have a darker body color; the gaster is piceous and the rest of the body "blood red", while in *subintegra* (the type series included) the gaster is medium brown and the remainder of the body yellowish red. Even in his original description, Emery made note of a series intermediate in color to *subintegra*. Fresh series in the Museum of Comparative Zoology grade through in this character; also, it has been our impression in the field that color is not reliable.

(2) The head has been considered more trapezoidal in *rubicunda*. We find that head shape shows great variation both intranidally, through allometry, and internidally, through different grades of allometry. We have been unable to separate two forms in any given size class on the basis of this character.

(3) *Rubicunda* has been considered to be distinguished by an emarginate dorsal petiolar border, opposed to an non-emarginate condition in *subintegra*. A glance at a small number of series is sufficient to show that this character grades through completely.

A syntype of *pergandei* in the Museum of Comparative Zoology appears in every aspect to be only a small but otherwise normal worker of *subintegra*. In full face view, a small space is left between the eye and the margin of the head, contrary to the key character presented by Creighton. But even if the eye extended to or beyond the margin, this would still not exceed the range of variation of *subintegra*, which is highly variable in head shape (see under *curiosa*).

Puberula, according to the diagnoses of both Wheeler and Creighton, is marked by the presence of raised pubescence on the scape, especially (according to Creighton) on the inner surface near the tip. The most extreme series we have examined, from Pullman, Wash. (W. M. Mann), has no more than four or five hairs raised at all strikingly from the surface along any single edge of the scape, and none of these makes an angle of more than 45°. Other western series show every gradation from this extreme to the typical, completely "smooth" *subintegra* condition. An intermediate pilosity has been encountered also in a series from Rogers City, Presque Isle Co., Mich. (P. B. Kannowski), but otherwise the *puberula* variant is mostly limited to the western United States.

Sublucida was erected by Wheeler for a single series, which he considered to have a distinctively smooth and shining body surface. Examination has shown that this series is really well within the normal range of variation of *subintegra,* and in fact is not far from average for that species. Wheeler's inability to recognize his own variety was revealed when he later inadvertently added a large part of the unlabelled *sublucida* type series to the *subintegra* section of his collection.

Perhaps the most extensive variation shown by *subintegra* is in quantity and length of body pilosity. At one extreme, exemplified by the type series, numerous hairs are present on the pronotum and mesonotum, at the junction of the basal and declivitous faces of the propodeum, and along the dorsal crest of the petiole. The pronotal hairs are especially abundant, fairly long and sinuous, and form a characteristic pattern, the anterior ones bending posteriorly and the posterior ones bending anteriorly, so that those at the very center often seem in side view to touch or cross at the tips. At the other extreme, recognized by Wheeler in his variety *gilvescens,* only a few scattered stubby hairs are present on the pronotum, and the mesonotum, propodeum, and petiolar crest are completely bare. The "typical" *subintegra* tends to have longer hairs throughout, e. g. the longest on the first gastric tergite (exclusive of the extreme posterior strip) may be 0.20 mm or more, while in the "*gilvescens*" extreme of equivalent size the longest may not exceed 0.06 mm.

Mr. P. B. Kannowski has recently expressed the opinion to us (*in litt.*) that what we call "the *gilvescens* form" perhaps represents a distinct species distinguished by the following characters supplemental to pilosity: occiput more rounded, petiole blunter and usually with an emarginate dorsal border, gaster usually lighter in color. We have examined in detail 54 nest series from all over the eastern United States (excluding available western samples, which may be complicated by the presence of possible sibling species such as *curiosa* and *wheeleri*). We have noted a weak tendency, with many exceptions, toward correlation in Kannowski's characters, but we have not been able to detect significant bimodality in any character or character combination.

F. subintegra appears to be an obligatory slave-maker, and the proportion of slaves to *subintegra* workers is normally higher than the corresponding ratio in *subnuda* nests. *Subintegra* occurs largely within the United States, usually at lower latitudes and altitudes than *subnuda*. It takes a great variety of slaves, including members of the *fusca*, *pallidefulva* and *neogagates* groups, and it can occupy a wide range of habitats from mesic even to somewhat xeric.

Formica curiosa Creighton (fig. 2)

Formica curiosa Creighton, 1935, Amer. Mus. Novitates, no. 773, pp. 5-8; worker, queen. Type locality: Lake McGregor, near Kalispell, Montana.

This species is presumed distinguishable by the queen, which is concolorous yellowish red. A careful examination of part of the type series has failed to reveal any characters which will surely separate the worker caste of *curiosa* from the worker caste of *subintegra* as we broadly conceive of it here. We have noted several character trends, however, which may prove significant as more collections are made in the future.

(1) The placement of the eye as described by Creighton may have some merit as a character, and we have attempted to refine it as follows: in the six *curiosa* syntypes

we have examined (head width 1.08-1.32 mm) the eyes extend prominently beyond the margins of the head seen in full face. In the majority of *subintegra* cabinet series, few or none of the workers range below 1.32 mm in head width. In those that do, the shape of the head and placement of the eyes are highly variable. Some approach the *curiosa* condition; e. g. Broadmoor, Colo. (W. M. Wheeler); Alamogordo, N. Mex. (G. v. Krockow); Bronxville, N. Y. (Wheeler). In others, the eyes do not approach the lateral margins; e. g. Pullman, Wash. (W. M. Mann); Breckenridge, Colo. (P. J. Schmitt); Tesuque Canyon, Hyde Park, N. Mex. (A. C. Cole); Manzanares, N. Mex. (M. Cooper). At least one series is intermediate: Manitou, Colo. (Wheeler); associated queens here are typical *subintegra* and do not approach the *curiosa* color character. In general, variation is primarily internidal, with allometric trends within single nest series remaining constant. The "*curiosa*" head shape may be more common in western series of *subintegra* — at least the tendency for the production of smaller workers of the *curiosa* size class seems to be stronger.

(2) Worker series from Culbertson, Mont. (E. O. Wilson) and Twin Falls, Ida. (Cole), unaccompanied by queens and therefore not definitely determinable, are so similar in pilosity and minor-worker head shape to the *curiosa* types that they have been tentatively associated with this species. If correctly determined, then they may provide the additional diagnostic character: larger workers (head width 1.45-1.65 mm) are present and differ from *subintegra* workers of equivalent size by having heads proportionately more massive and with a slightly more quadrate frontal outline (figs. 1,2).

(3) The body pilosity of the *curiosa* types and Culbertson and Twin Falls series is very long and abundant, with numerous hairs on the mesonotum, but still within the extreme range of variation of verified *subintegra*.

(4) The first gastric tergite, exclusive of the extreme posterior strip, is yellowish brown in color and contrasts with the remainder of the gaster in the larger *curiosa*

types and Culbertson workers, but resembles the *subintegra* condition in the Twin Falls series.

(5) All three series have relatively short antennal scapes consistent with the western *subintegra* population.

Formica parcipappa Cole

Formica parcipappa Cole, 1946, Ann. Ent. Soc. Amer., 39: 616; worker. Type locality: Nampa, Idaho.

The diagnostic character lies with the reddish yellow gaster of the worker, little or no darker than the alitrunk. We can find no structural characters that will separate the meager known sample of *parcipappa* from *subintegra,* and the light color will have to be the basis upon which this species uneasily rests. The "*gilvescens*" form of *subintegra* is frequently nearly as light and as close to concolorous as the *parcipappa* types, but the extent to which such coloration is due to tenerality or cabinet fading remains unknown. Dr. Cole (*in litt.*) assures us that the *parcipappa* types were noted as near their present striking hue when collected alive.

The variable lightening of the anterior gastric segments in some western series of *curiosa* (see above) suggests a condition intergradient between the gastric pigmentations of bicolorous *subintegra* and concolorous *parcipappa.* This species will remain doubtful at least until additional material is studied.

Formica wheeleri Creighton

Formica wheeleri Creighton, 1935, Amer. Mus. Novitates, no. 773, pp. 1-5; worker, queen. Type locality: Warner Ranger Station, La Sal Mountains, Utah, 9500 feet.

This species is supposed to be separable by the dark brownish tone of the head and alitrunk of the queen, and by the generally reduced size of this caste; the head is only slightly larger than that of the largest workers. No characters have been discovered that will surely separate the worker caste of *wheeleri* from that of *subintegra.* Workers in the type series possess very deep clypeal notches and show light cephalic infuscation, but both features are within the extremes of the range of variation of verified *subintegra.* We have tentatively associated with *wheeleri* a series from Madison Junction, Yellowstone Park, Wyoming, 6800 feet (E. O. Wilson). The queens are smaller than eastern *subintegra* at our disposal and appear darker despite their teneral condition. The workers differ from the *wheeleri* types by the possession of a shallower clypeal notch and "*puberula*" pilosity type (see under *subintegra*). A queen collected with workers by A. C. Cole at Dailey Canyon, Beulah, New Mexico, 8000 feet, is intermediate between the Yellowstone series and eastern *subintegra* in size and color. We have not been able to see a syntype queen of *wheeleri,* but judging from Creighton's description alone, the gap between *wheeleri* and *subintegra* appears to be filled by the Yellowstone and Dailey Canyon series. Future collecting in the Rockies and Great Basin may reveal that *wheeleri* is nothing more than one of the western variants of *subintegra.*

THE OBTUSOPILOSA COMPLEX OF THE NEOGAGATES GROUP

In the light of their new association with *F. neogagates* and relatives, the *obtusopilosa* group species must now all be re-evaluated. It is possible that some additional synonymy previously obscured by the false *Raptiformica-Proformica* dichotomy will be established when the *neogagates* group meets its first comprehensive revision. Such revision is not attempted here.

Formica bradleyi Wheeler

Formica bradleyi Wheeler, 1913, Bull. Mus. Comp. Zool. Harv., 53: 423-425; worker, male. Type locality: Georgetown, Colorado.

Formica (*Proformica*) *neogagates* var. *morbida* Wheeler, 1913, *ibid.,* pp. 538-539; worker, queen. Type locality: Lenox, Iowa. Synonymized under *F. neogagates* Emery by Creighton, 1950, p. 459. NEW SYNONYMY.

Syntypes of *bradleyi* and *morbida* in the Museum of Comparative Zoology have been compared, and are closely similar, corroborating Dr. Buren's findings. *F. bradleyi* differs from *neogagates* in its much lighter color and denser and longer body pilosity.

Formica manni Wheeler

Formica manni Wheeler, 1913, Bull. Mus. Comp. Zool. Harv., 53: 420-421; worker, queen. Type locality: Kiona, Washington.

Formica oregonensis Cole, 1938, Amer. Midl. Nat., 20: 368-369; worker. Type locality: Pendleton, Oregon. NEW SYNONYMY.

Four paratypes of *oregonensis* in the Museum of Compartive Zoology are identical to the type series of *manni* in nearly all characters studied. Only the two characters treated below seem worthy of further discussion.

(1) Creighton (1950) states that the largest workers of *oregonensis* exceed the largest of *manni* in size. However, the M. C. Z. *oregonensis* paratypes show a head width range of 1.05-1.27 mm, while the M. C. Z. *manni* type series ranges 0.97-1.29 mm. There is no indication of a significant mean difference between these two samples.

(2) The alitrunk and head of the *oregonensis* types are dark brown, while those of the *manni* types are clear yellowish red. This difference apparently reflects geographic variation, i. e., a tendency to darken southward. Series from Wenatchee and Wapato, Wash. (Mann) are similar to the *manni* types in coloration. Series from Ellensburg, Wash. (Mann), Twin Falls, Ida. (Cole), and Hammett, Ida. (E. O. Wilson) exhibit varying degrees of intermediate infuscation. A single queen from Owens Lake, Calif. (H. F. Wickham) has a slightly darker altitrunk than the *manni* gynetype, but an even lighter head.

The extreme coloration of the *oregonensis* types may be a consequence, either genetic or ecophenotypic, of the unusual environment in which they were collected. Cole found them on an herb in an alpine meadow above timberline. The Washington *manni* (Wheeler, 1913) and the series from Hammett were taken under radically different conditions at low elevations in desert habitats.

Manni may be following Gloger's rule, tending to darken in a cooler, moister climate.

Formica obtusopilosa Emery

Formica obtusopilosa Emery, 1893, Zool. Jahrb. Syst., 7: 648-649; worker. Type locality: New Mexico.

Formica munda var. *alticola* Wheeler, 1917, Proc. Amer. Acad. Arts Sci. Boston, 52: 534; worker. Type locality: Jefferson Co., Colo., 9500 feet. NEW SYNONYMY.

Formica obtusopilosa alticola Creighton, 1950, Bull. Mus. Comp. Zool. Harv., 104: 466.

Wheeler's variety *alticola* was based on workers differing from typical *obtusopilosa* (= *munda*) only by a darker body color, a character of demonstrably little taxonomic value in other "*sanguinea* group" members. Creighton retained *alticola* because of the possibility that it might represent a geographic altitudinal variant. We are inclined to discount even this possibility now, in view of the fact that a collection of workers as dark as the *alticola* types has recently been made in scrub desert at 6000 feet near Junction, Piute Co., Utah (E. O. Wilson). The position of *obtusopilosa* as to species group is at present very uncertain, and may not be settled until males are studied.

Formica perpilosa Wheeler (figs. 4, 6)

Formica fusca subpolita var. *perpilosa* Wheeler, 1907, Mem. Revist. Soc. Ant. Alzate, 17: 141; worker. Type locality: Canyon City, Colo.

Formica perpilosa Wheeler, 1913, Bull. Mus. Comp. Zool. Harv., 53: 421.

Acknowledgements

After the first draft of this paper had been prepared, we were privileged to examine a near-finished manuscript by Dr. W. F. Buren dealing broadly with the subject of group classification within the genus *Formica*. The correspondence between Buren's and our ideas on this subject are frequently close and detailed (within the scope of

our own present paper), and most of the morphological observations bearing on species-group affinities are identical, even though independently accomplished. Dr. Buren has graciously deferred to us in the mention of a few points discovered by himself where these are necessary to a clear understanding of the group affinities of the species treated below, and for this we are most grateful. It is inconvenient for us to indicate in the text all points that should be credited in whole or part to Buren's original work, but it can be emphasized that his contribution was indeed an important one. Treatment of species within the *sanguinea* group, however, is entirely original with us.

We have also consulted for purposes of this study Dr. A. C. Cole, Mr. P. B. Kannowski, and Dr. Mary Talbot (all of whom also furnished important series), Dr. W. S. Creighton, Dr. R. E. Gregg and Dr. M. R. Smith. We thank these workers for their criticisms and information.

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DIVISION OF LABOR IN A NEST OF THE SLAVE-MAKING ANT *FORMICA WHEELERI* CREIGHTON

By Edward O. Wilson
Biological Laboratories, Harvard University

It is a well known fact that most of the dulotic *Formica* are not "host-specific." They normally employ several species as slaves and are apparently governed in their choice at least in part by the species that happen fortuitously to be accessible to the colony. *F. subintegra* Emery, for instance, most commonly enslaves *F. fusca* Linn., but I have seen it associated in cabinet series with *F. lasioides* Emery, *F. neogagates* Emery, and *F. schaufussi* Mayr, while Creighton (1950) records it in addition with *F. montana* Emery and *F. pallidefulva* Mayr. According to Forel (1928, p. 12), the slave workers may retain some of the behavioral traits peculiar to their species. He notes that in Europe *Formica pratensis* Retzius workers reared from pupae by *F. sanguinea* Latreille tend to construct the form of nest characteristic of their own species. Talbot and Kennedy (1940) have made observations suggestive of the same behavior in *F. fusca* enslaved by *F. subintegra*. When *sanguinea* workers kept in observation nests were induced by Forel (*op. cit.*, p. 126) to rear pupae of *Polyergus rufescens* (Latreille) and several common *Formica* so that all these species coexisted in the same nest, differences in behavior were noted: "the *F. exsecta* and *fusca* were distinguished by their activity in working, the *Polyergus* by their complete idleness, the *sanguinea* by their skill, and the *pratensis* by their clumsiness."

During a recent field trip through the western United States, I was able to study in some detail a remarkable compound colony of the slave-maker *F. wheeleri* Creighton[1] and two slave species (*F. neorufibarbis* and *F. fusca*) in which behavioral differences were so strong as to produce a clearcut interspecific division of labor. The complex organization of this colony was so interesting in every detail that I have considered it worthwhile to record below all of my observations, despite the fact that they pertain to a single and possibly aberrant case.

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[1] A tentative determination, since the status of this species relative to *F. subintegra* is still uncertain; see the preceding article by Wilson and Brown.

The mixed colony was first encountered at 2:30 on a warm, sunny afternoon, July 20, 1952, in a meadow near Madison Junction, Yellowstone Park, Wyoming (elevation 6800 feet). The *wheeleri* workers, accompanied by large numbers of *neorufibarbis* and a very few *fusca*, were in the process of raiding two nests simultaneously, one of *fusca* about eighteen feet from the home nest, and another of *lasioides* about seven feet beyond in a straight line. The exteriors of both raided nests were inconspicuous, each consisting of nothing more than several entrance holes in the open ground. The *wheeleri-neorufibarbis* raiding file contained workers spaced at intervals averaging about six to eight feet. Most were halting at the *fusca* nest, but some were bypassing it and proceeding on to the smaller *lasioides* nest. The scene around the raided nests was one of outstanding confusion. Frenzied *fusca* and *lasioides*, some carrying brood, were mingled with the *wheeleri* and *neorufibarbis* slaves. Running over the same spot were *fusca* and *neorufibarbis* from alien nests, possibly drawn to the scene by the general excitement. Needless to say it was difficult at any given time to pick out the slaves, the ants being raided, and the extraneous marauders.

Many of the homeward bound *wheeleri* were transporting pupae, *neorufibarbis* slaves, and other *wheeleri*. The *neorufibarbis* were never laden and seemed to be running back and forth without contributing any service to the raid. On a single occasion a *fusca* slave was observed carrying one of its *wheeleri* mistresses. The method of adult transport was the same as that already described in the literature for other *Formica*: the ant to be carried was approached face-to-face, seized by the mandibles, and lifted aloft; it submissively curled its body under the head of its transporter, folded in its legs, and became completely still.

After observing the raid for about an hour, I excavated the *fusca* nest in part. My efforts were clumsy, and I succeeded only in turning up a few workers and blocking the main entrance galleries. But at this point the role of the *neorufibarbis* was revealed, for as soon as I buried the access to the nest, they joined in with the *wheeleri* workers to dig it out again. There was no hesitation in this act, despite the fact that they did not follow through to join in the actual pillaging.

The raid continued through the remainder of the afternoon, the intensity of activity fluctuating as from time to time the number of workers issuing from the home nest rose and then fell again. After 4:00 the raid against the *lasioides* began to slacken, and by 5:15 it had ceased altogether. By 5:30 activity around the *fusca* nest was also noticeably less.

When the raid had fallen into an obvious decline, around 5:30, I proceeded to excavate the *wheeleri* home nest. The exterior consisted of a low, oblong earthern mound about two-and-a-half feet in maximum length and three inches high. Sparse tufts of grass emerged through the periphery, at one end sheltering three inconspicuous entrance holes. By digging a pit four feet deep in from the side, I uncovered the deepest galleries of the nest at about three-and-a-half feet. Inside the nest the *wheeleri* were outnumbered by their slaves by at least three to two, while the *neorufibarbis* and *fusca* occurred in approximately equal numbers. No *lasioides* were encountered, despite the fact that the *wheeleri* had been engaged in a raid against a nest of this species earlier in the day. The upper galleries and chambers of the nest contained large numbers of *wheeleri* and *neorufibarbis* and a few small individuals of *fusca*. The former two species sallied out aggressively to defend the nest. The deeper galleries, those at a depth of about two feet or more, were larger in size and packed with large *fusca* workers, *wheeleri* brood, callow *wheeleri* queens (a single fully colored male was also found), and a small number of *wheeleri* and *neorufibarbis* workers. The *fusca* workers were relatively docile, and nearly all were in a semi-replete condition. Their preponderance over other adults in this part of the nest and their close association with the brood gave the strong impression that they were serving as nurses.

At noon on the next day the wrecked nest was visited again. The colony was busily engaged in migrating to the undamaged part of the *fusca* nest which had been raided the day before. The *fusca* workers were no longer in evidence and presumably had been forced out. The *wheeleri* were doing all the work in this operation; most of the workers in the migrating file were carrying something in their mandibles, either brood, or slaves, or other *wheeleri*. In contrast, many of the slaves were running back and forth with the slave-makers but none were burdened.

In summary, an interspecific division of labor was pronounced in this particular case. The slave-maker species *wheeleri* functioned in raiding, nest defense, and transport during colony migration. Workers of the slave species *neorufibarbis* accompanied the *wheeleri* on their raid and helped them excavate one of the besieged nests when the entrance holes were blocked; they were also active in nest defense. The *fusca* workers were very passive, did not contribute materially to the slave-raid, and gave every sign of serving primarily as nurses and food receptacles. A deeper significance of the dulotic habit is underscored here. It is apparent that the slave-maker colony not only adds to its labor force quantitatively by taking slaves but may also incorporate specialists that increase the efficiency of the colony in a fashion analogous to that seen in normal worker polymorphism.

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NOTE ON *TARSOPHLEBIOPSIS MAYI* TILLYARD (ODONATA: TARSOPHLEBIIDAE)

By Lt. Col. F. C. Fraser, I.M.S., Retd.

Bournemouth, England

I wish to correct a serious error made by the late Dr. R. J. Tillyard when describing his *Tarsophlebiopsis mayi* Tillyard[1]. I am indebted to the Curator of the Sedgwick Museum, Cambridge University, for the opportunity of re-examining this very interesting fossil wing, an examination which convinces me that we are not dealing with a fore wing and a hind wing as Tillyard supposed, but with the right and left fore wings. Tillyard was no doubt swayed by the fact that the impression of the supposed hind wing is pigmented whilst that of the fore wing is not so; he also based his opinion on what he thought to be a greater divergence of the origins of Rii (Mi--ii) and IRiii (Ms), a divergence which seems to me to be identical in the two impressions. His greatest error, however, is his statement that the fossil shows *unspecialized antenodals,* which in so archaic a wing is *absolutely impossible.* It was to prove this latter point that I requested a loan of the specimen and found after my re-examination that the two primary antenodals were indeed present. By making careful sketches of the portions of the wing to the same scale and then making a combined tracing of the two, I found that the various longitudinal veins ran in smooth continuation of one another and that they were obviously both portions of a forewing, the left and right of the insect under examination. Some differences were also found in the anal area of the wing, where only two cross veins can be seen running between CuA and CuP and only four in the cubital space. The slight reticulation in the distal part of this space shown by Tillyard appears to me to be due to foreign matter or artefacts. The primary antenodals are the 3rd and 5th from the base of the wing. The reticulation posterior to the anal vein is of three rows of cells, not a network as shown

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[1] 1923, Geol. Mag., **60**: 146-52, 1 pl., 3 figs.

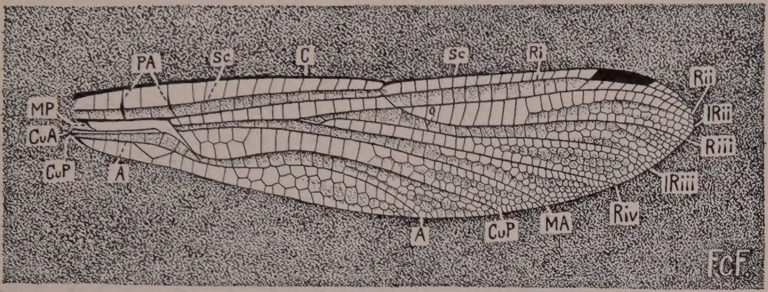

Fig. 1. Reconstruction of fore wing of *Tarsophlebiopsis mayi* Till. (Tillyardian notation employed).

by Tillyard. The supposed fragment of "the basal posterior margin of a hindwing" fits into the area posterior to the anal vein in the right fore wing. After making these corrections, I have been able to reconstruct a complete fore wing.

NYLANDERIA MYOPS (MANN), NEW COMBINATION (HYMENOPTERA: FORMICIDAE). — The small-eyed Cuban *Prenolepis* of Mann is placed in *Nylanderia* to follow the modern classification of these groups. Weber has described a species *troglodytes*, also from Cuba, supposing it to differ from *myops* "in distinctly larger size and in the shape of the petiole." Direct comparison of three syntypes of each of these forms now in the Museum of Comparative Zoology shows a slight average size difference, but an absolute overlap exists even in this minute sample. Mann's cited measurements are too low, and could not have been made from a stretched-out specimen. Head and petiole shapes in these delicate specimens vary widely, due to warping and buckling upon drying out of the alcohol. Weber apparently refers to such differences, although these are not clearly seen in the types before me. Formal synonymy follows. *Prenolepis myops* Mann, 1920, Bull. Amer. Mus. Nat. Hist., 42: 432, worker, female, male. Type loc.: Mina Carlota, Sierra Trinidad.

Paratrechina (*Nylanderia*) *troglodytes* Weber, 1934, Rev. Ent., Rio de Janeiro, 4: 58, fig. 7a, b, worker. Type loc.: near Casa Harvard, Soledad, Cienfuegos, Cuba. **New synonymy.**

In addition to specimens collected at or near the two type localities by P. J. Darlington and E. O. Wilson, Darlington took a series at the Sierra de Cobre, from 3000-3800 feet altitude, Oriente Prov., Cuba, showing that the species is both widespread and ecologically adaptable within the limits Cuba offers. — By WILLIAM L. BROWN, JR., Museum of Comparative Zoology.

THE STATUS OF THE ANT GENUS MICROBOLBOS DONISTHORPE. — During a recent visit to the British Museum (Natural History) I was able to examine the holotype of the enigmatic species *Microbolbos testaceus* Donisthorpe, described from the Gold Coast (1948, *Entomologist*, 81: 170-171)). *Microbolbos* was found to be a junior synonym of *Leptogenys* Roger 1861 (*s. l.*) (**new synonymy**). Donisthorpe's *testaceus* may stand as a valid species, however, distinguished from other *Leptogenys* by the following combination of characters: (1) hind claws with small, well separated teeth instead of combs, (2) mandibles with 3 distinct teeth including the apical, (3) body size extremely small, only about that of a large *Ponera*, (4) body surface heavily shagreened, completely opaque, (5) color dark yellowish brown, (6) body covered with abundant, short, erect hairs. The absence of combs on the tarsal claws, or at least their reduction to separated teeth, forms an exception to what is the principal diagnostic character of the Leptogenyini, but actually the African species *Leptogenys arnoldi* Forel and *L. castanea* Mayr show the same condition, and the character grades through between the two extremes in the genus. Possession of mandibular teeth additional to the apical tooth is also unusual, but is shared with *L. myops* Emery and members of the *L. processionalis* group. — E. O. WILSON, Biological Laboratories, Harvard University.

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